Design for a Combat Casualty Care Medical Information System (CCC/MIS).

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DESIGN FOR A COMBAT CASUALTY CARE MEDICAL INFORMATION SYSTEM (CCC/MIS)*

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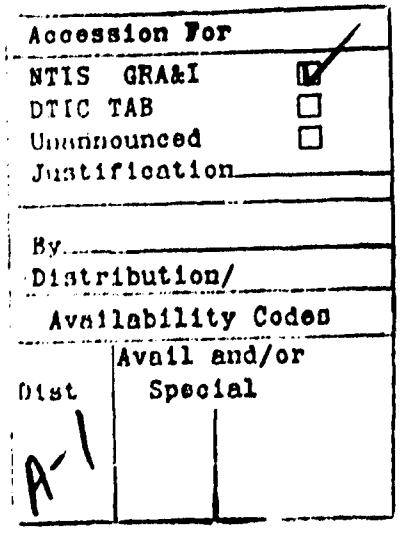

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Summary

The Navy and Marine Corps have, over the last decade, recognized the need to develop a system for medical units operating in the field to replace the current manual paper and pencil methods used for the collection of Combat Casualty Care Medical Information. Implementation of an automated system would allow for the complete and accurate maintenance of field medical records while patients are processed through a series of different treatment locations. Having been tasked to determine Marine Corps requirements, NHRC conducted a rigorous systems analysis of current procedures used by field medical units for casualty treatment. This led to the formulation of functional specifications and a conceptual design for a system prototype including a full list of proposed hardware to implement the system. The proposed components of the system were field tested for survivability and utility under typical field medical company conditions. This resulted in a fully operational system which was then demonstrated for the Marine Corps at Camp Pendleton.

It was determined that the utilization of such a system could significantly increase the accuracy and reliability of patient data, while reducing the time and manpower required for patient processing by automatically recording and updating administrative records. The administrative burdens of four to six full-time medical personnel could be eliminated by implementing such a system. The design and capabilities of the system are discussed including hardware layout, system operation and component integration.

DESIGN FOR A COMBAT CASUALTY CARE MEDICAL INFORMATION SYSTEM (CCC/MIS)

Overview

Over the last decade, the Navy and Marine Corps have recognized the need to develop a combat casualty care medical information system for medical units operating in the field[1,2,3]. It is expected that such a system would be much more efficient than the current manual paper and pencil methods and thus reduce the administrative burden on field medical units. Implementation of an automated system would allow for the complete and accurate maintenance of field medical records while patients are processed through a series of different treatment locations known as echelons.

The Naval Health Research Center (NHRC) in San Diego was tasked to determine the Marine Corps requirements and explore potential methods of assembling such a system. After some initial investigation[4,5] and the development of a preliminary design[6], a rigorous systems analysis of current procedures used in the treatment of combat casualties was completed[7]. The results of that analysis indicated that often medical information is not available when needed. Medical personnel are pushed to their limits at peak conditions; consequently, they can do no more than provide essential care to casualties. At such times, the philosophy is adopted that treatment of patients comes first and filling out paper work will be done when time permits.

The systems analysis showed that certain administrative data are essential to create internal status boards and update various resource management reports. However, collection of these data is an additional burden on medical personnel. Nearly all staff personnel are required, at some time, to participate by making updates to logs noting time, date, and patient status. In addition, people are needed to integrate and tabulate the information into reports, and other people are required to communicate this information both within and outside the organization. Altogether, the equivalent of between four to six full-time personnel are required just to meet the patient processing needs of a typical field medical company.

Required System Functions

After completion of the systems analysis, it was determined that an automated medical data collection and reporting system was feasible and desirable. A proposed functional design for a prototype system was then formulated and is outlined below.

Functional Specifications

- o Patient Demographic and Medical History Data should be Stored Electronically
  - An extract of personnel and medical data should be stored to a small electronic device and worn like a dog tag.
  - Electronically encoded data devices should be provided in garrison prior to combat.
  - The data device should be easily machine and human readable for quick identification and information retrieval.
  - Important treatment information should remain with patient as he goes through the treatment echelon system.
  - Information stored on the data device should update the patient history and provide a double check against paper records.
  - The capability should exist for transferring medical information from the data device to a larger data base at any time for research or tactical purposes.

- o There should be an Automatic Patient Registration Capability
  - A data device reader located wherever patients are admitted should be used to check in all casualties and immediately update centralized patient files.

    All previous patient data should be available to medical personnel, and patient check-in time would be greatly reduced (no logs or keyboard data entry).

    Patients should be automatically assigned a patient number and next location designator.

    Certain decisions should be automated or accelerated by accessing patient data upon arrival.
  - A centralized patient record file should be immediately initiated for use elsewhere in the Medical Company.
  - Provide automatic alert for needed resources (blood, staff, medication).

- There should be Automatic Patient Tracking and Location Designation.
  - Automatic input devices should be used throughout the medical compound in a fashion that allows data to be entered more quickly, more easily, and more accurately than manual methods.
  - Patient logs should be eliminated at all areas within the medical company.
  - Automatic assignment of time, date, location should be appended to patient tracking files.
  - Central patient files should be updated in real time.
  - Resource files should be automatically provided.
  - Automatic location determination and assignment of casualties within the medical company ("traffic control") should be integrated into the system.

- Provide Resource Management
  - Automatic updates of data bases used for status reports should be generated along with automatic spot status reports (beds, blood, staff location, consumables).
  - This system should generate interactive reports request and data review reports (patient flows, backup areas).
  - There should be an option to: 1) reorder consumables automatically; 2) automatically estimate projected usage of consumables; and 3) analyze consumable usage through interactive queries.

- Maintain a Combat Medical Record
  - The system design should include specialized data collection forms to take advantage of data entry capabilities.
  - Data entry methods should be fast, easy to use, and accurate. Automatic data entry equipment such as graphic pad, mouse, bar code, touch screen, and audio input could be utilized.
  - Updates to the patient medical record should occur immediately upon data entry.
  - Built-in decision trees could be developed to determine required response prompts for essential medical data.
  - Automatic paper file updates (printouts) should be supplied upon request.

- o Maintenance Functions
  - Maintain directories
  - Access Codes
  - Backups
  - Maintain a journal file

- o The following General Administrative functions should be provided
  - Automatic patient discharge (log time, date, location, disposition).
  - Communication within and between the medical company and rear echelons.
  - Administrative reports should be generated automatically.
  - During very busy times the system should be designed so that it could be operated by walking wounded.
  - Automatic generation of medical regulating reports should be provided.
  - Data entry and output devices should be distributed within the medical company to facilitate real-time input and output of administrative information such as staff location.

Conceptual Design

Any ADP system consists of a combination of hardware and software. However, because of the nature of casualty care, the hardware that is available is somewhat more critical than is the case for other medical information systems. Therefore, the conceptual design will address the specifications for the hardware first which provides a context for the software design.

System Hardware

A major consideration in designing an information system for use in Marine Corps field medical operations is the survivability of the component hardware. Conditions can be quite harsh from the standpoint of weather, as well as how the equipment is stored, transported, and handled. After testing various types of equipment for both functionality and survivability, a preliminary prototype was developed and demonstrated for the Marine Corps[8]. The basic concept of this proposed system met with tentative approval, but some changes were suggested for both hardware and software capabilities. This resulted in the following operational prototype concept:

- One IBM-AT compatible microcomputer (host)
  - 4MB RAM expansion board
  - Radio frequency communications board
  - 20MB hard disk drive

- Four ruggedized portable microcomputers
  - One containing a 20 Megabyte hard disk drive
  - One containing a 5 Megabyte removable hard disk drive
  - Two containing 1/2 Megabyte bubble memory boards

Each of the micros will have one or more of the following data input devices attached.

- Two Electronically Erasable Programmable Read-Only Memory (EEPROM) reader/writers
- One graphics digitizer tablet
- Eight hand-held microcomputers with built-in bar code reader
- One electronic mouse
- Four bar code wedge readers
- Voice recognition device
- Voice synthesizer
- Touch screen
- Radio frequency tag reader/writer

Each simulated casualty will have an electronic encoded data device which is worn as an ID tag along with the standard dog tags. At one station this key will be replaced by a radio frequency tag which is somewhat larger and more bulky.

System Layout

The hardware listed will be deployed throughout the Marine Corps Field Medical Company (see figure 1). A company generally consists of several patient wards, a surgical area containing two or three operating rooms, a pre-op area, and a post-op recovery room. There are various support facilities along with laboratory and supply areas. The Triage and Admitting and Sorting areas are essentially the front door to the Medical Company with the back door being the Medical Operations Center (MOC)/patient affairs area. This is also the control center for the entire compound, linking all the

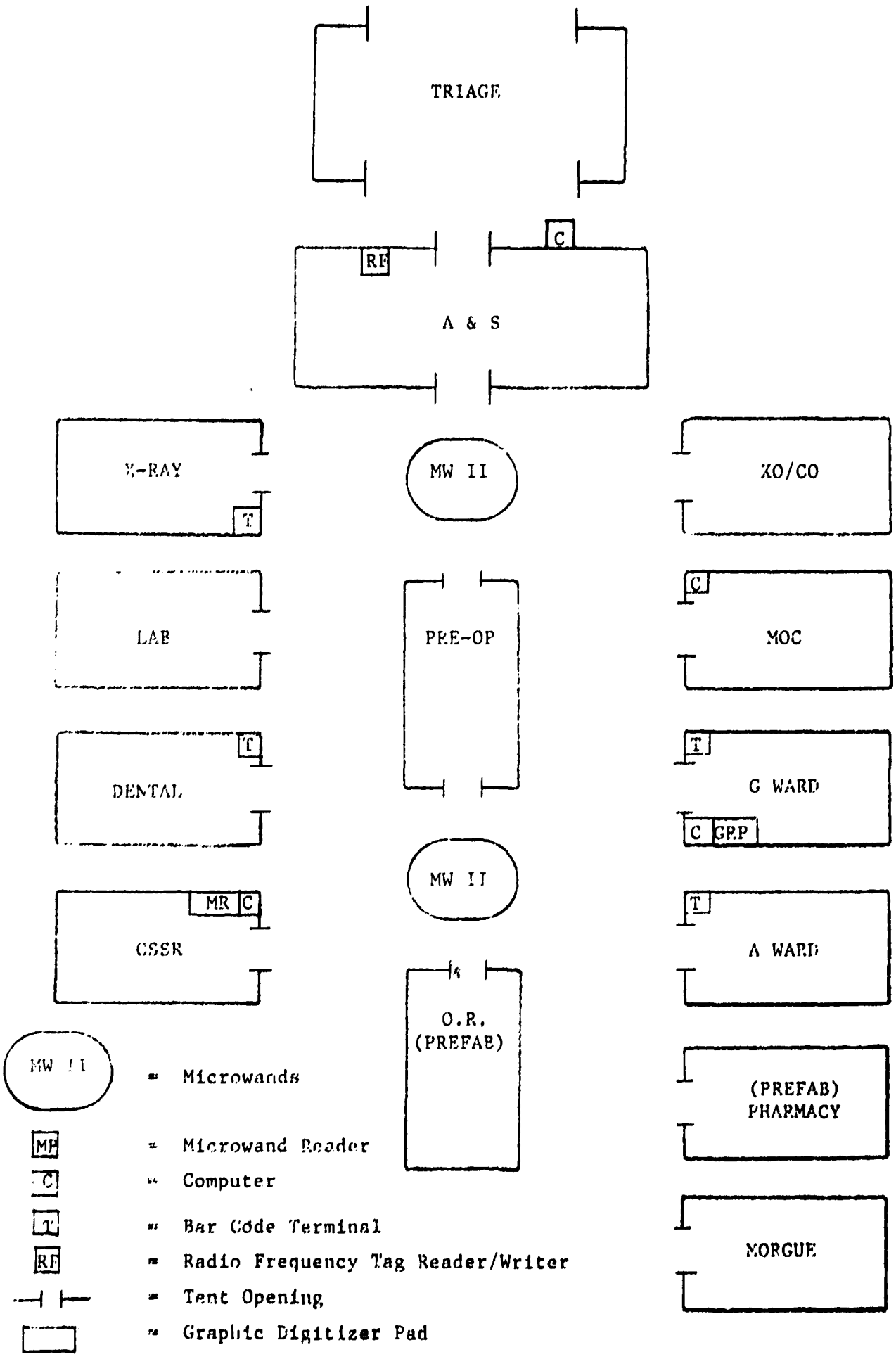

Figure 1. Typical Field Medical Company Layout

treatment areas together. MOC will house the main microcomputer (IBM-AT compatible) which will serve as the hub for the multi-user system. The four PCs will be located in strategic areas to operate as stand alone units or to function as part of the multi-user system by supporting various peripheral components. For example, one PC will be located in one of the patient wards and will support a network of several hand-held micros equipped with barcode readers. The same computer will also allow input from a graphics digitizer tablet and other non-keyboard types of data input devices that will be used to update patient medical files. Other PCs will support the electronically erasable programmable read only memory (EEPROM) units, barcode readers, mouses, and printers.

System Operation

The following description outlines how it is envisioned the system will operate.

As patients are brought into the Medical Company area they are first carried by stretcher to the triage area. A corpsman removes the information tag (EEPROM) and places it into the tag reader. At that moment all of the casualties' identification and pertinent medical history is flashed on a monitor, a patient control number is automatically assigned, a triage category is requested, and the person is automatically registered into the medical company including time and date of admission, blood type, allergy, required medication, and the next logical location for the treatment of this type of casualty. The information tag is then replaced and another patient is registered.

Under ideal circumstances the information device mentioned would be a radio frequency (RF) tag. It is envisioned that every medical company will maintain a number of RF tags to be used as needed. During the registration process an RF tag can be automatically recorded and placed on the patient litter. Readers/writers placed at the entrance and exits of each area where a patient might be treated automatically registers and records patient movement both on the RF tag and within the system. Currently, such tags are bulky and expensive; therefore, it is more practical to label patients with bar codes and use bar code readers to accomplish this function. However, it is expected that the size and cost of RF tags will decrease in the near future.

Medical information relating to type and location of injury and the specific treatments administered continue to be recorded on standardized forms (see Figure 1). However, this data can now be entered quickly into the system by nontechnical (walking wounded) personnel. This happens at the Wards after the casualty has passed through the various treatment areas and has stabilized. A graphics pad equipped with an electronic pointer is utilized to capture the data and integrate it with other patient information[9]. As patients move throughout the compound a constant update is automatically maintained and displayed in the MOC area.

Upon checking out of the Medical Company at the MOC area the patient's identification tag is updated with all the pertinent events and treatment received and discharge occurs. At this point, a full set of medical records is maintained at the Medical Company, but the casualty also has a condensed version to be carried to the next duty station or treatment facility.

Conclusion

It is emphasized that during the above systems analysis, system design, and concept testing, frequent contacts were made with Marine Corps medical units. During this process a variety of procedures were proposed, discussed, tested, and evaluated. The system outlined in this paper represents the results of this effort to define a field automated system that will lead to improved patient care and medical resource management and utilization. However, as new technology becomes available or medical doctrine is modified, the above conceptual design may need to be revised.

LAST NAME	FIRST NAME	M I	SOCIAL SECURITY NUMBER

PATIENT MANAGEMENT

TREATMENT FACILITY	FIELD CORPSMAN		BATTALION AID STA		MED/HOSP CO		FLEET HOSPITAL	
ARRIVED	Date	Time	Date	Time	Date	Time	Date	Time
TREATMENT	Date	Time	Date	Time	Date	Time	Date	Time

VITAL SIGNS

DATE	TIME	TEMP	PULSE	BLOOD PRESSURE SYS / DIAS	RESP RATE	RESP EXPAN	CAP REFILL	EYE OPEN	VERBAL RESPON	MOTOR RESPON
				( )/						
				( )/						
				( )/						

INJURIES

TYPE OF INJURY

1 DISLOCATION
2 FRACTURE
3 LACERATION
4 PUNCTURE
5 TRAUM AMPUTATION
6 BOUND
7 CONCUSSION
8 WHITE PHOS BURN
9 OTHER BURN
10 OTHER INJ

_____

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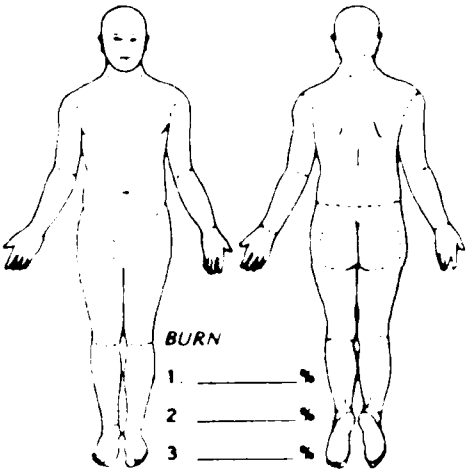
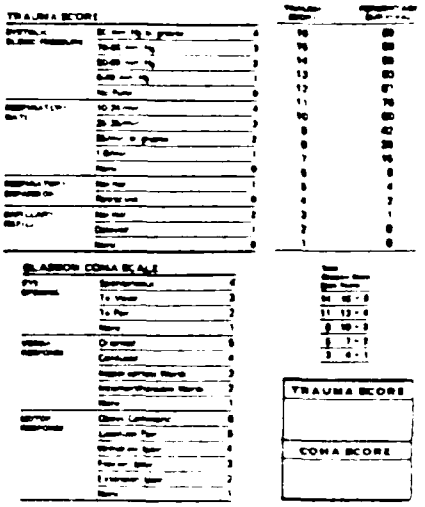


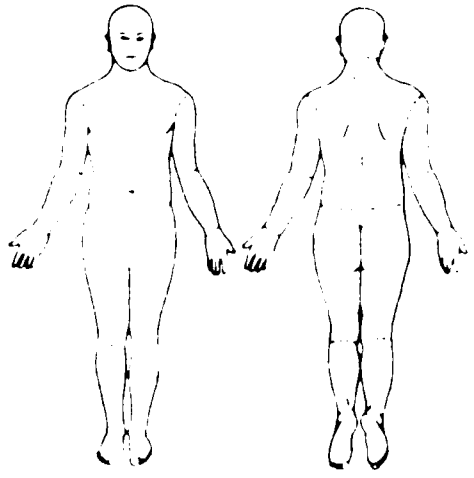


TREATMENTS

1 BANDAGE
2 TOURNIQUET
3 SPLINT
4 APPLY HEMOSTAT
5 TRACHEOTOMY
6 SUTURES
7 OXYGEN
8 DECONTAMINATION
9 CAST
10 OTHER

_____

_____



TUBES

1 ENDOTRACH
2 CHEST
3 N G
4 FOLEY CATH

ANESTHETICS

REGIONAL

1 SADDLE BLOCK
2 EPIDURAL
3 AXILLARY
4 I V

FIELD

1 XYLOCAINE
A W/EPI
B W/O EPI

Figure 2. Proposed Replacement for the Field Medical Data Card (DD 1380)

MEDICATIONS

	DOSE	ROUTE PO/IM-IV/SUBQ	DATE	TIME	DATE	TIME	DATE	TIME
NARCOTICS MORPHINE OTHER								
SEDATIVES DIAZEPAM OTHER								
ANTIBIOTICS PENICILLIN TETRACYCLINE SULFA OTHER								
ANTIDOTE ATROPINE OTHER								
TOPICAL SPECIFY								
IMMUNIZATIONS TETANUS TOXOID VACCINE OTHER								
OTHER MEDICATIONS								
I.V. SOLUTIONS RINGERS NORMAL SAL D5W OTHER		GAUGE NEEDLE						

TRIAGE CLASSIFICATION

1 MINIMAL
2 DELAYED
3 URGENT
4 EXPECTANT

FINAL DISPOSITION

☐ RETURNED TO DUTY
☐ EVACUATED - MODE
- ☐ AIR
- ☐ LAND
- ☐ SEA
- ☐ OTHER _____

☐ DIED OF:
- ☐ BATTLE INJ
- ☐ NON-BATTLE INJURY
- ☐ DISEASE
- ☐ BURNS
- ☐ SUICIDE
- ☐ CHEM AGENT
- ☐ BIOLOGICAL AGENT
- ☐ RAD. AGENT
- ☐ OTHER _____

PROVIDER NOTES

REFERENCES

1. American Institute of Biological Sciences, Report of the Naval Medical Research and Development Command and Office of Naval Research Technical Workshop on Combat Casualty Care, April 1976.

2. Headquarters U.S. Marine Corps (MED) and Naval Medical Research and Development Command, Proceedings of the FMF Medical Information Systems Definition Workshop, May 1982.

3. Gunderson, E.K.E., Congleton, M.W., and Ramsey-Klee, D.M. Proceedings of the Conference on Fleet Marine Force Combat Casualty Care Information Systems, Report No. 84-15, NHRC, 1984.

4. Garland, F.C. Medical Care Quality Evaluation Using the Fleet Marine Force Medical Information System. Report No. 83-33, NHRC, 1983.

5. Bollinger, C.W., Pugh, W.M. Automation of Marine Corps Casualty Medical Data Management. Report No. 83-35, NHRC, 1983.

6. Pugh, W.M., Borkat, F., Bollinger, C.W., Congleton, M., Gunderson, E.K.E. Preliminary Design of a Combat Casualty Medical Information System. Report No. 83-34, NHRC, 1983.

7. Congleton, M.W., Wilcox, W.W., Pugh, W.M., and Bartok, A. Information Flows at the Forward Echelons of Casualty Care. Report No. 86-23, NHRC, 1986.

8. Wilcox, W.W., Pugh, W.M. The Combat Casualty Care Medical Information System (CCC/MIS) Prototype. Report No. 86-32, NHRC, 1986.

9. Sager, T.J., Pugh, W.M.. A CAD System for the Capture of Combat Casualty Care Information. Report No. 87-35, NHRC, 1987.

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Information obtained from a rigorous systems analysis of current field medical treatment procedures was used to produce the functional design for a prototype casualty care medical information system. The design objectives were to: 1) reduce time spent on administrative functions; 2) eliminate the loss of important patient data, and 3) generally improve patient care and medical resource management. After field testing various proposed automated features to determine their survivability and functionality, a preliminary working prototype was assembled and succesfully demonstrated for the Marine Corps. The layout and operational design for implementing a full-scale system was presented. Keywords: (with key predicting)

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